Clear Radiance Studies
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In the N^* or η formulation

$$I_{clear} = I_{warm} + \eta^* (I_{warm} - I_{cold})$$

one solution is obtained for each pair of points.

In the slope approach, all points can be used. The solution is

$$I_{clear} = \bar{I} + \text{slope}[I_{clear}(\text{ref.}) - \bar{I}(\text{ref.})]$$

where the slope is obtained by the usual least squares solution to the 9 points in the 3 by 3 array. One slope is obtained for each predictor channel.

$$\text{slope} = \frac{\Sigma[I - \bar{I}]x[I(\text{ref.}) - \bar{I}(\text{ref.})]}{\Sigma[I(\text{ref.}) - \bar{I}(\text{ref.})]^2}$$

For high peaking channels, the true slope is zero, but the measurements are noisy. For a sample of 9, the noise produces a slope that is usually significantly different from zero. If the slope is set to zero, the question becomes on of determining at which height to switch from averaging to doing the correction. One way of minimizing the error is to use eigenvectors for the slope. The slope becomes

$$\text{slope} = \frac{\Sigma[PCS - \overline{PCS}]x[I(\text{ref.}) - \bar{I}(\text{ref.})]}{\Sigma[I(\text{ref.}) - \bar{I}(\text{ref.})]^2}$$

where PCS denotes the Principal Components Scores of the radiances. Since there are fewer PCS than channels, the channel noise is reduced. The danger of loosing information is reduced by calculating the average of I rather than the average of the PCS for the first term.

Note however, that it is possible to take eigenvectors of the difference rather than the difference of the eigenvectors. The reason for doing this is that the differences are all zero for the higher peaking channels, meaning that the eigenvectors should produce zero and the estimate should be the average value. The trade is that the eigenvectors should recognize the cloud situation. This was tired and did reduce the error for the upper channels. However, it did not work for the lower peaking channels. The best solution is to use the eigenvectors for the channels, not the eigenvectors for the cloud effects.

This study revealed that eigenvectors have to be used with some caution. There can be a problem with the use of eigenvectors for some situations. If a measurement is for a very high peaking cloud with a large cloud amount, the energy for the shortwave channels is essentially zero. This can lead to negative radiances. Also, if all measurements are too cold, the slope becomes zero, although this case should be trapped by other tests.

Angle Adjustments

There is a need to make local angle adjustments for cloud clearing. There are two approaches that might be considered.

1. Do a retrieval based on cloudy radiances. Then integrate the radiative transfer equation.
   a. Probably accurate.
   b. Slow

2. Do a regression for the angle correction.
   a. Accuracy is good.
   b. Fast

3. Note that the correction must be done on cloudy radiances.

4. Angle adjustments based on IR radiances have marginal accuracy at the outer scan angles.

5. Retrievals based on IR and AMSU have good accuracy.

6. We are evaluating the use of IR + AMSU for angle adjustments.

Tuning

1. The tuning algorithm was transferred to JPL.

2. Several machine dependent differences were resolved by setting options.

3. JPL is looking at an apparent dependency of the eigenvectors on the machine. The code gives different values on different machines. Such code is very dependent on accuracy and this is the probable cause. All other differences have been resolved.

Cloud Clearing

1. The code is being revised to work with the 100 layer model. (Note! This is the first time some of the modules have been run since a change in programmers. The documentation has saved a lot of time, but we have discovered a couple areas where it needs to be improved.)

Adjustment of Radiosondes

Radiosondes need to be adjusted because measurements from different instruments have systematic differences. Although the differences are systematic, they are profile dependent. If they are to be compared to a single instrument such as AIRS, the systematic differences should be removed.

1. Test on HIRS

Attempted

a. Find profiles with similar radiances
b. Profiles with different temperature structures have similar radiances

To Try

a. Find profiles from different types with similar radiosonde profiles.
b. Use the differences in measured radiances to calculate a temperature adjustment - (Profiles are not identical)
c. Predict the radiance difference from the temperature.

Transmittance Studies

1. Generated OPTRAN coefficients for AIRS (+IASI + ITS)
2. Using Larrabee's layer to space transmittances for OPTRAN to generate AIRS transmittances

3. OPTRAN
   - Generates coefficients as a function of absorber amount not pressure
   - Predictand is smooth so interpolation is easy
   - Architecture is easy to vectorize (has been done)
   - Interpolate coefficients to pressure space
   - Radiative transfer calculation in pressure coordinates
   - Inclusion of angles is easy
   - Change in pressure is easy - can be used with sigma layer models
   - Change in CO_2 concentration is easy
   - For water vapor, the range of the Predictand is much smaller
   - Code is on the Internet
   - Why would one use pressure coordinates?

4. Future studies
   - OPTRAN for eigenvectors of absorber coefficients
   - Planck equivalent for broad band region